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Hello David,

Before explaining how the two-layer torch-on membrane system works, and answering your specific questions, it is appropriate to provide some background history to their use in New Zealand.

The original multilayer systems comprised reinforced rolls (or Felts) which were laid by hot-pouring bitumen on to the roof substrate and embedding the rolls in over-lapping layers in the molten bitumen which was melted in gas-fired kettles right on the roof. These systems were in use from prior to World War Two right up to the 1960s. Around that time bitumen composite sheets and subsequently in the 1970s rolls were introduced that did not require the hot pour method but could be laid with gas-fired torches much more cleanly and effectively. As the bitumen composite formulations improved, so did the laying characteristics of the roll products. As a consequence the system became much more widely used in the 1980s and 90s so that the system is one of the most commonly used low slope membrane roofing systems.

These products are not manufactured in New Zealand but are imported by a number of suppliers, most of whom are members of the WMAI, and who control the product distribution and application through applicator networks. As a consequence the applicators in turn follow the requirements of the WMAI Torch-on Code of Practice which contains extensive section on site practice, health and safety and fire safety.

You cannot just go to the local builder's merchant, obtain the materials and start laying torch-on roofs.

There are variations to the suppliers systems, but the principles are similar.

The substrate is commonly plywood, concrete or a PIR (polyisocyanurate) insulation board.

There are other variations of the same substrates. In all cases the substrate is primed with a liquid form of bitumen with a viscosity that allows it to penetrate the substrate.

The first layer (base sheet) comes in roll form usually 3mm thick by 1 metre wide and about 10 metres long. This is torched with a flame to melt the under-surface of the sheet at approximately 140 degrees C. depending on the composition of the material. The bitumen should melt with a continuous molten surface which bonds with the primed substrate. As it cools from a liquid to a solid the bitumen is 100% bonded to the substrate.

The laps and details are then laid with a smaller torch. This gives the roof a continuous watertight membrane.

The second layer (Cap Sheet) is installed over the first layer in the same direction but offset from the base sheet laps. The laying method is the same as the first. The main difference is the stone chip top surface which provides a durable weather and UV resistant membrane. The thickness is 4mm with similar length and width as the base sheet.

With a plywood substrate the plywood is fully supported in accordance with standard design criteria with solid timber or steel around all sheet joints. The sheets are tightly butted together. It is exceptionally unlikely an installer can get a fire to start while installing the membrane.

To answer your specific questions

- 1) The gas torch is used to heat the adhering surface of the membrane to its melting point only.
- 2) The gas torch is activated with a flint or lighter after the gas has been turned on at the gas bottle with supply controlled by a regulator at the bottle. The gas stays alight at the nozzle in the torch using the mixture of gas with air at the nozzle. The main heating flame is activated with a spring-loaded "dead man" lever. The actual ignition source is a gentle pilot flame. Depression of the lever increase the gas flow to operating condition. Release of pressure automatically reverts the torch to pilot flame status.
- 3) Having explained operation as above, operation is further safeguarded by the shape and construction of the torch which has a either a bent neck in the torch stem or a built-in stand together with a windshield to protect the pilot flame, The result of this is that is the torch is laid down on the roof surface the flame will face upwards at an angle which prevents it impinging directly on the surface.
- 4) Yes the pilot flame will remain on when the torch is left unattended, but it is susceptible to being extinguished by wind currents. It is not possible for the flame to reach operational condition if the torch is left unattended, because of the Dead man lever activation.
- 5) Anything is possible in theory, but there would be absolutely no practical advantage in so doing, as all control in the application process would be lost.
- 6) The surface of the bitumen roll to which the flame is applied melts to a thin liquid film. When the flame is removed the film cools within seconds and reverts to the solid state. It should be noted that most roll products are supplied with a very thin plastic film on the face of the bitumen. This is vaporised very quickly during the initial flame impingement on the roll surface and this process is almost immediately followed by the transformation of the bitumen surface to the liquid state to adhere to the surface underneath. The contact time between flame and bitumen is a matter of seconds only.

Trust the above summary provides a clearer understanding on reinforced modified bitumen membranes, their installation procedure with a gas torch and the operation safeguards within the equipment.

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